

Headquarters Science Mission Directorate (SMD)

SMD Program Types



SMD manages the following five types of flight programs:

1. Single-project programs (Cassini, James Webb Space Telescope)
2. Multi-project, strategic, roadmap-initiated series (Mars Exploration, Living with a Star)
3. Multi-project, AO-initiated series (**Discovery, New Frontiers, Explorers, Mars Scout**)
4. Multi-project, reimbursable S/C development for other agencies (POES, GOES)
5. Instruments for non-NASA partner missions as MOs (Herschel, Rosetta, **M³. Strofio**)

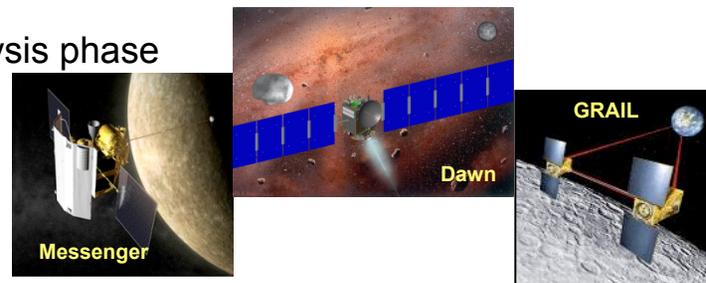
Source: SMD Handbook

- Both D&NF are “multi-project, AO-initiated”, uncoupled programs based on the following:
 - Currently 10 projects total
 - Discovery – 8 projects ongoing, AO for next just released
 - New Frontiers – 2 projects ongoing, next in Phase A study
 - All D&NF missions are Announcement of Opportunity (AO) initiated
 - Each project is independent of the other projects in the Program

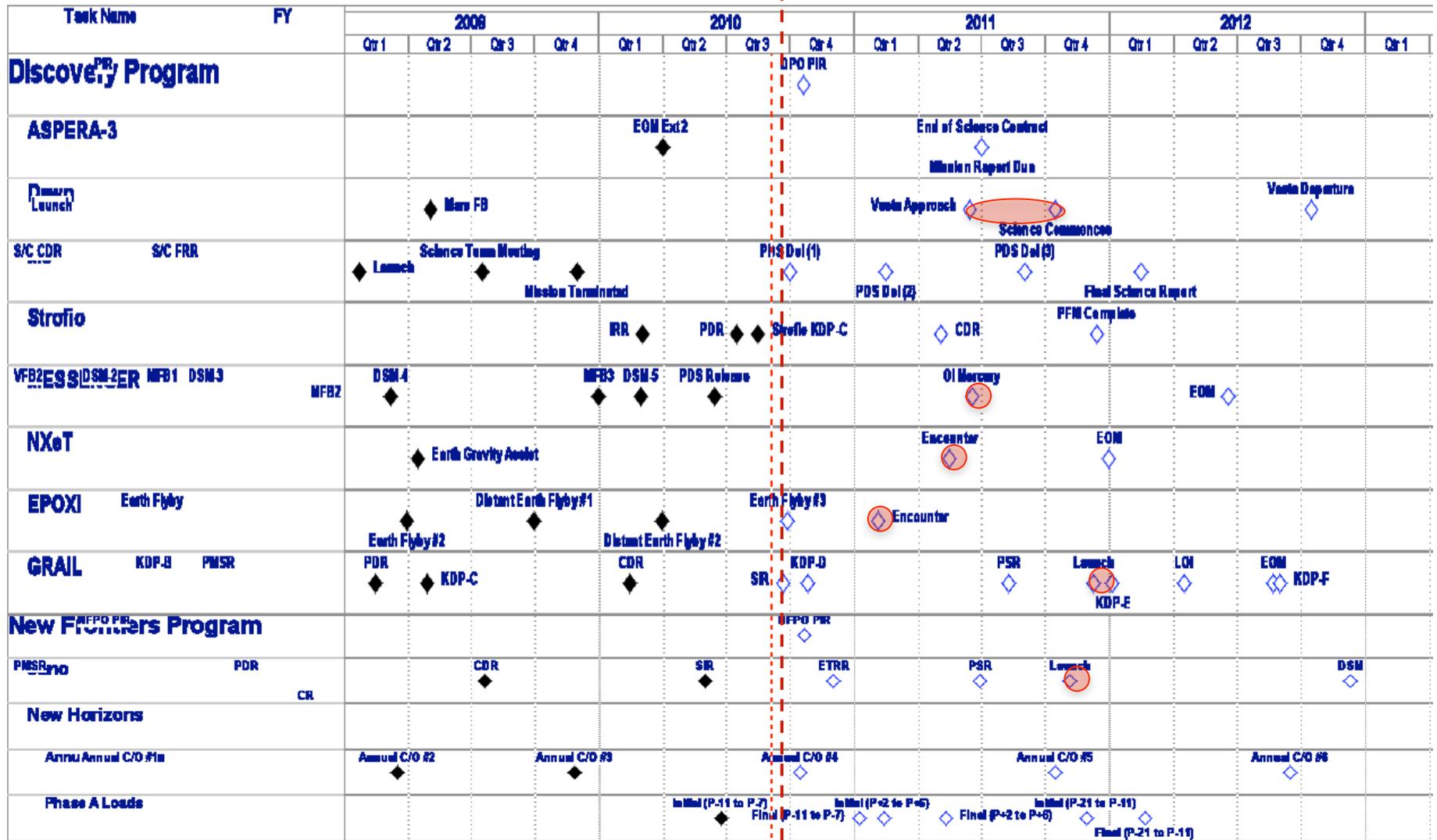
Discovery Program Background



- The Discovery Program was initiated in 1992 as a way to ensure frequent access to space for planetary science investigations. AOs were released in 1994, 1996, 1998, 2000, 2004, 2006, and now 2010.
- The completed missions (7) in the Discovery Program are NEAR, Mars Pathfinder, Lunar Prospector, Genesis, Deep Impact, and Stardust. CONTOUR was lost shortly after its launch in 2002
- The four missions currently in development, operation, or analysis phase are MESSENGER, Dawn, Kepler (transferred), and GRAIL
- Three MoOs, Aspera-3, Netlander, and the Moon Mineralogy Mapper, have been selected in full AOs
 - Netlander was terminated before launch
 - ASPERA-3 is currently operating on ESA's Mars Express
 - Moon Mineralogy Mapper has completed operations on ISRO's Chandrayaan-1.
- Two MoOs have been selected under the SALMON AO and incorporated into the Discovery Program: Strofio and Lander Radio (LaRa on hold).
- Additionally, three investigations reusing spacecraft are in operation:
 - EPOCH and DIXI are hosted by the Deep Impact spacecraft and have been joined to produce the EPOXI mission
 - Stardust-NExT is hosted on the Stardust spacecraft



D&NF Programs Master Schedule

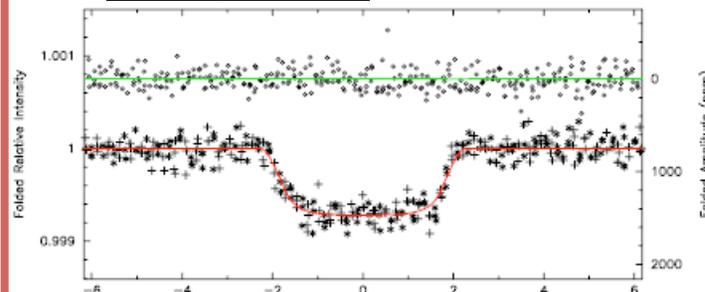
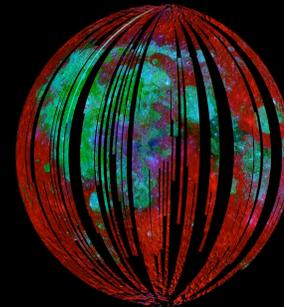
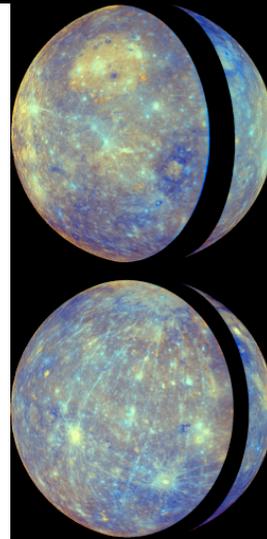


D&NF Programs

Major Milestones and Activities



- ✓ EPOXI Earth Flyby #1 – December 2007
- ✓ MESSENGER Mercury Fly-by #1 – January 2008
- ✓ GRAIL PMSR – April 2008
- ✓ Juno PDR – May 2008
- ✓ Juno Confirmation – August 2008
- ✓ M³ Launch – October 2008
- ✓ MESSENGER Mercury Fly-by #2 – October 2008
- ✓ GRAIL PDR – November 2008
- ✓ EPOXI Earth Flyby #2 – December 2008
- ✓ GRAIL Confirmation – January 2009
- ✓ Stardust-NeXT Earth Gravity Assist – January 2009
- ✓ Dawn Mars Flyby – February 2009
- ✓ New Frontiers AO 3 Announcement – April 2009
- ✓ Juno CDR – April 2009
- ✓ Strofio Selected – June 2009
- ✓ M³ Operations Terminated - August 2009
- ✓ MESSENGER Mercury Fly-by #3 – September 2009
- ✓ Kepler Transition from DPO to EEPO – October 2009
- ✓ GRAIL CDR – November 2009
- ✓ Kepler Transition from JPL to ARC – December 2009
- ✓ New Frontiers AO 3 Downselect – April 2010
- ✓ Juno SIR – March 2010
- ✓ Strofio PDR – April 2010
- ✓ Discovery AO 2010 Announcement – June 2010
- ✓ EPOXI Earth Flyby #3 – June 2010
- ✓ GRAIL SIR – June 2010



- EPOXI Encounter – November 2010
- NExT Encounter – February 2011
- MESSENGER Orbit Insertion – March 2011
- Discovery 12 Phase A selections ~ March 2011
- Dawn Vesta Orbit Insertion – July 2011
- Strofio PSR – July 2011
- Juno Launch – August 2011
- GRAIL Launch – September 2011

Headquarters Science Mission Directorate

Management Approach / Philosophy (1 of 2)



- The Planetary Science Division in SMD works with the planetary science community (Decadal Survey & PSS) to establish the strategic roadmaps and scientific goals for NASA's planetary science exploration activities
 - The D&NF Programs are vehicles that help implement this roadmap by performing relatively frequent, high-quality planetary science investigations using innovative and efficient management approaches
 - SMD selects missions, establishes program priority by balancing the scientific imperative of each investigation against the cost, technological readiness, and other considerations
 - Each program emphasizes missions that can be accomplished under the leadership of the scientific research community
- Each program is governed by a Program Management Council (PMC)
 - New Frontiers projects are typically governed by Agency PMC because of budget levels, but could be delegated to SMD PMC
 - Discovery projects are typically governed by SMD PMC unless using RPS

Headquarters Science Mission Directorate

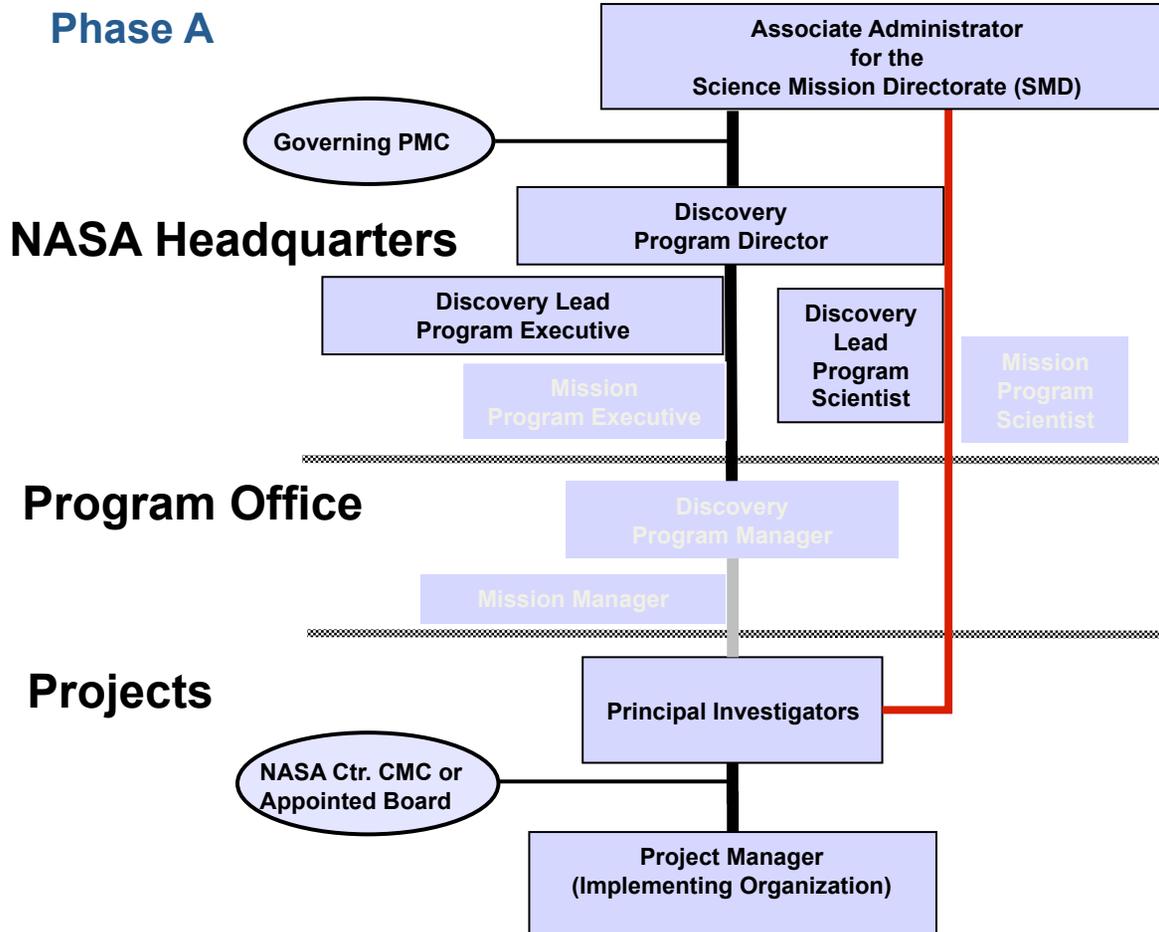
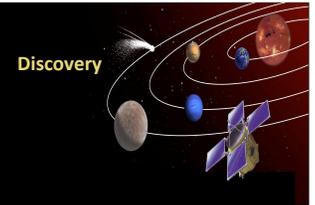
Management Approach / Philosophy (2 of 2)



Major SMD Responsibilities

- SMD implements its Headquarters responsibilities through a Program Director (PD)
 - Provides overall guidance to the program at NASA Headquarters and Field Centers.
 - Exercises full authority over the content and budget of the Program including:
 - Establishing Program-level strategic goals and policies
 - Developing and maintaining the D&NF Program Commitment Agreements (PCA)
 - Advocating the planetary science programs with key customers and stakeholders to ensure necessary support for success
 - Ensuring effective Program communications across SMD and NASA
 - Submitting D&NF technology needs into the SMD technology programs
- SMD provides scientific guidance and oversight of the programs and missions via a lead Program Scientist (PS) for each program.
 - PS leads each program's mission solicitation, Phase A activities and the final mission selection process.
- SMD Associate Administrator (AA) selects the projects – full missions and missions of opportunity (MoO)
- SMD assigned Lead Program Executive maintains program level budget and technical oversight, acting for the Program Director on daily issues
- SMD-assigned Program Manager (at MSFC) oversees development and operation of the SMD-selected projects from both planetary science programs

Program Structure Selection - Phase A



Phase A contracts are established through the Program Office, however this service is performed as a support function to the Program Scientist.

The Program Office has no other role in the selection process.

Mission Managers follow the Phase A process in preparation for Phase B

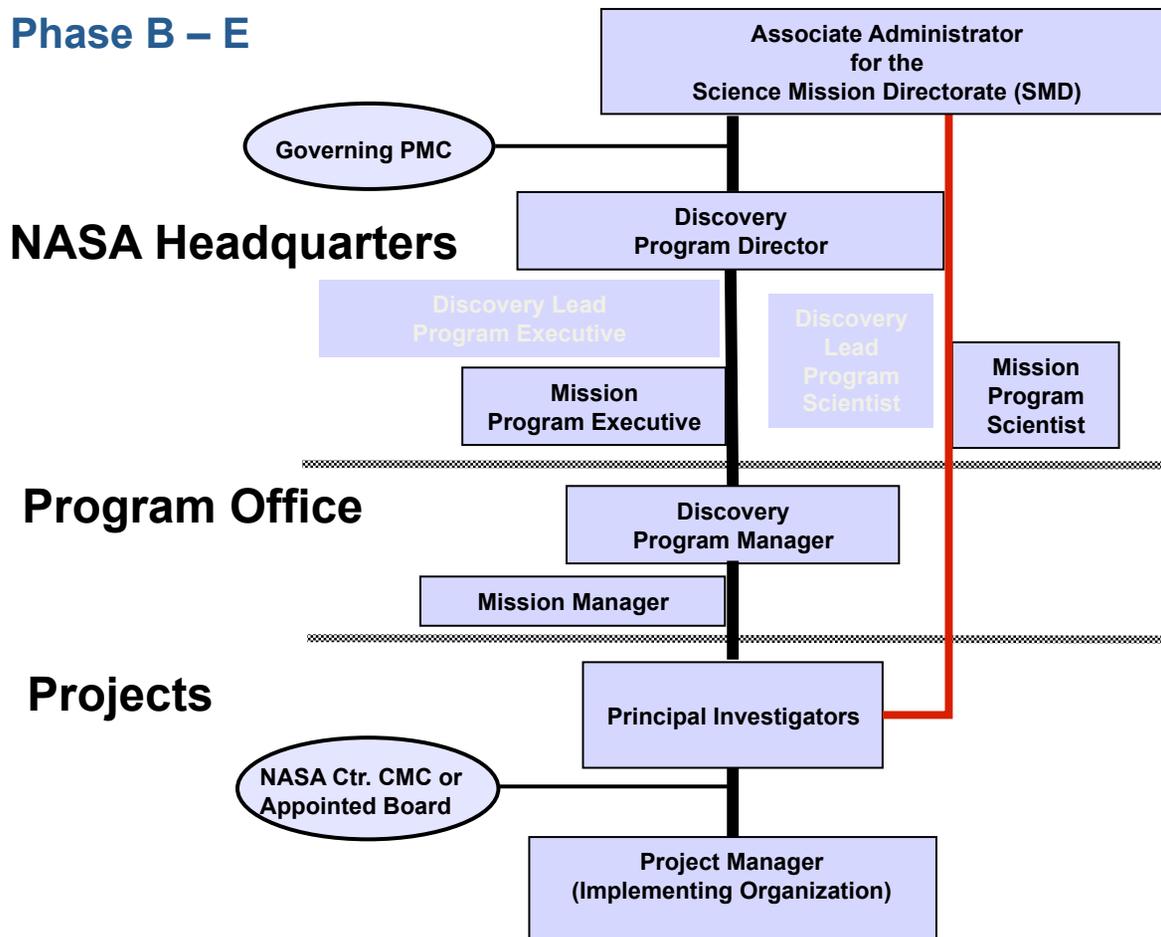


Program Structure

Phases B, C, D, E



Phase B – E



With Phase B, mission specific Program Execs & Scientists at NASA HQ and a Mission Manager at the PO will be assigned to assist the reporting, advocacy and oversight of the project.



Headquarters Science Mission Directorate

Relationships to Projects



Following the selection of a project:

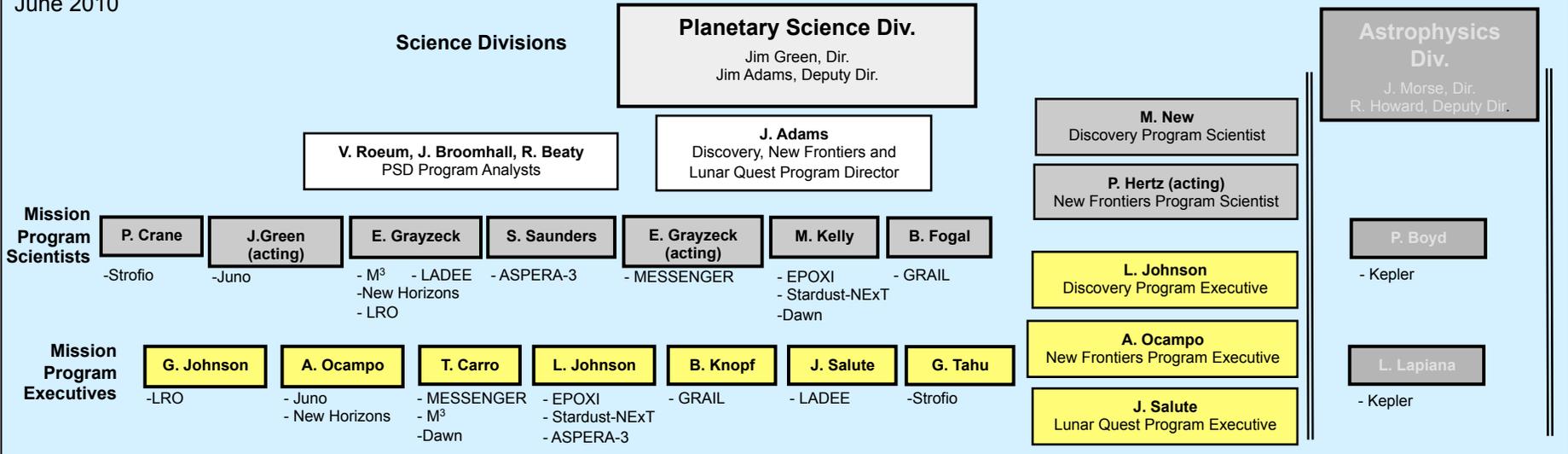
- SMD approves top-level requirements and mission success criteria for each selected mission, confirms missions for implementation, establishes international and inter-government agreements, and monitors and assesses project and program implementation
- SMD Program Executives (PE) staff these responsibilities, working with PS's, the PO, and the projects to achieve approval of the top-level mission requirements and mission Confirmation (both by the AA). The PE's perform the SMD monitor/assessment function at HQ
- The Mission PE for each project maintains cognizance of the project's programmatic health via regular contact with the project during implementation (Phase B, C, D, E), principally by exposure to reports from the project, monthly status and major milestone reviews, access to assessments coordinated by the PO, and ad hoc interactions deemed necessary to assess project performance for the Program Director and SMD AA. The Mission PE advises and reports to SMD management as required
- The Mission PS for each project maintains cognizance of the project's scientific integrity versus the selected science objectives via regular contact with the project during implementation (Phase B, C, D, E), principally by exposure to monthly status reviews, and further interactions with PI and science team. The Mission PS advises and reports to SMD management as required

Headquarters Science Mission Directorate Program Office: Headquarters Organization



NASA Headquarters Science Mission Directorate (SMD)

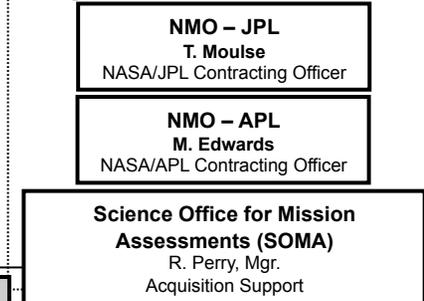
June 2010



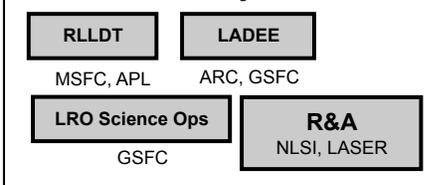
Program Office



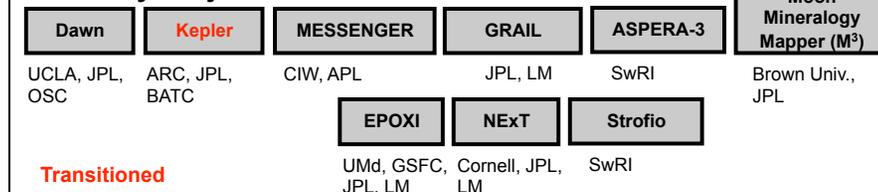
Program-level support



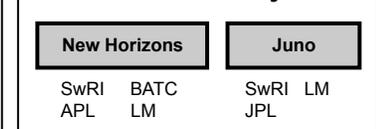
Lunar Quest Projects



Discovery Projects



New Frontiers Projects



Discovery/New Frontiers Program Office

Goal

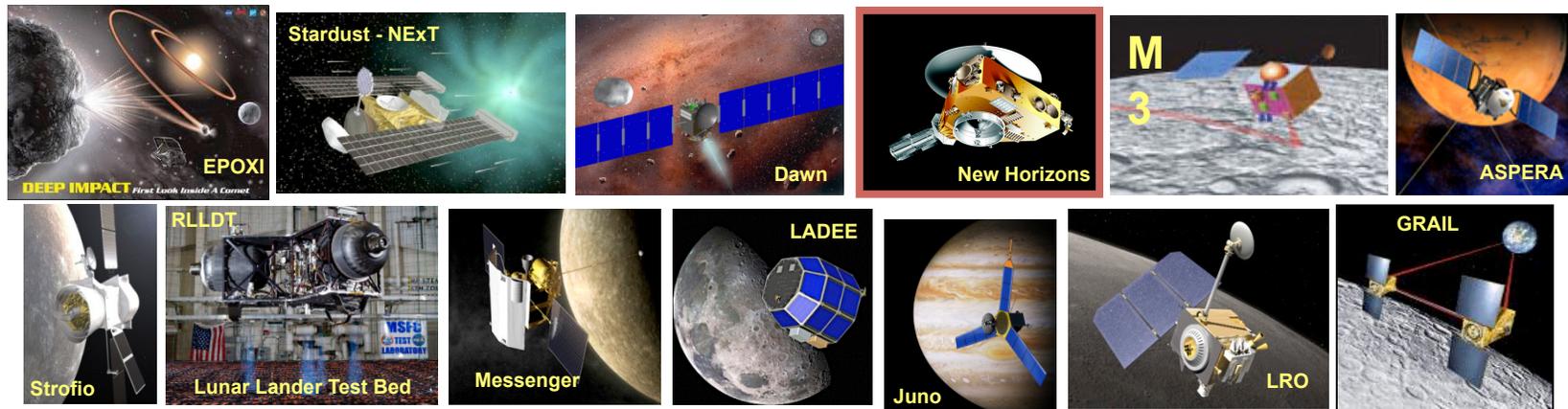


Goal

- ◆ Enhance the probability of mission success of Discovery Projects through independent oversight and insight through all phases of the mission life cycle utilizing a high-powered, effective, and efficient team.

Success is.....

- ◆ Delivering Mission Science to the PI (meet the Level I requirements)
- ◆ Ensuring the implementing organization's success in delivering the spacecraft on cost and schedule (meet the launch date and cost cap)
- ◆ Meeting the Program launch frequency for Science Missions



Program Office *Philosophy*



Approach

- ◆ Shared partnership for mission success with Headquarters and project teams. Right level of Government involvement to mitigate program risk

Relationships

- ◆ Role: Implement our role as a program office, while recognizing the responsibility and authority of the projects and institutions
- ◆ Fairness: Operate with integrity and fairness at all times with all parties
- ◆ Trust: We will approach new relationships with an attitude of trust
- ◆ Respect: Recognize the dedication and capability of the PI & project teams, especially during times of problems

Program Office Organization



Discovery, New Frontiers, Lunar Quest Program Office
 Program Manager Dennon Clardy
 D&NF Deputy Program Manager Allen Bacskey
 LQ Deputy Program Manager John McDougal
 Office Support Asst. Sandra Nixon

Program Integration Office
 Integration Manager Bill Kahle
 Integration Analyst Marilyn Newhouse
 Integration Analyst Tom Hushka
 Schedule Analyst Nate Porter
 Integration Engineer Paul Galloway
 LQ Integration Support Karen Stephens

Business Office
 Business Office Manager Donna Patterson
 Program Analyst Derek Wiseman
 Program Analyst Stephanie Allen

Procurement Office
 Contract Officer/Mgr Mark Stiles (Acting)
 Contract Specialist Belinda Triplett
 Contract Specialist Iris Walter

Education & Public Outreach
 D&NF E&PO Lead Shari Asplund/JPL
 LQ E&PO Lead Brian Mitchell
 LQ E&PO Support Stephanie Wilson

Program Technical Authority
 Lead Chief Engineer, D&NF Judy Ballance
 Asst. Chief Engineer, D&NF Mike Galuska
 Lead Chief Engineer, LQ Bryan Barley

Program Safety & Mission Assurance
 S&MA Lead Dr. Ruth Jones

Mission Managers

Jimmy Lee

Steve McClard

Rick Turner

Randy Baggett

Brian Key

MESSINGER

New Horizons

Strofi

M³

LRO Science Ops*

LADEE

Dawn

ASPERA-3

GRAIL

Juno

Stardust-NExT

EPOXI

RLLDT

Discovery Missions
 New Frontiers Missions
 Lunar Quest Missions

*Future mission

Program Office

Primary Responsibilities



◆ Implement 7120.5 Program Management functions

- Split responsibility between the SMD Program Director and Discovery Program Manager
- Program Manager focus is implementation of Phases B, C, D, E

◆ Perform limited oversight and insight of projects (budget, schedule, technical and risks) (Phase B, C, D, E)

- When, where and how deep to penetrate determined by assessment of risks and modulated by available budget

◆ Manage program implementation budgets (Phase B, C, D, E)

- Independently assess project performance to plan
- Ensure projects receive required funding per plan
- Collect POP data from projects, provide integrated assessment/input to SMD

◆ Administer contracts (Phase A, B, C, D, E)

- Execute Task Agreements with JPL, perform COTR function on APL missions, and execute contracts with PI institutions



Roles and Responsibilities

- ◆ After selection, **Principal Investigators** are responsible to the Program Manager for programmatic success and to the AA for SMD for scientific success
 - **Principal Investigator** (PI) vested with overall responsibility for scientific integrity and mission success
 - **Project Manager** is responsible to the PI for the successful development and implementation of the mission. They report to their institutional management and programmatically through the Discovery Program Manager
- ◆ **Program Manager** is responsible for mission project formulation, development, launch, on-orbit checkout, mission operations, and data analysis
 - Ensuring that the Discovery project adheres to committed cost, schedule, performance, reliability, safety requirements, and E&PO
 - Discovery Program Office works directly with Project Manager in accomplishing the mission, particularly in the areas of resource allocation and utilization, oversight, reporting, and resolution of project issues
 - **Mission Managers** act on behalf of the Program Manager and are the primary Program Office interface for Principal Investigators and Project Managers

Specific roles are defined in the Discovery Program Plan (DISC-PLAN-001), available on-line in the Discovery Program Library; <http://discovery.larc.nasa.gov/discovery/dpl.html>



Mission Managers

Key Roles and Responsibilities

- ◆ **Mission Managers (MM)** function as the PMs day-to-day point-of-contact for all assigned projects, performing technical and programmatic management functions on behalf of the PM and ensuring the PM maintains an awareness of the project status. The MM responsibilities include:
 - Interface directly with the Project Managers to develop inputs for program planning and integration or to resolve project issues
 - Perform independent evaluation of project metrics, schedule, cost data, management, and issues for the PM
 - Perform independent assessments of projects to identify risks and mitigations
 - Serve as the Program Office advocate to NASA management, the public, and other Government entities for assigned projects
 - Lead the development of decision packages or products that are fully coordinated within the Discovery Program and with the related PIs and Project Managers
 - Ensure that appropriate program resources are provided to the projects in a timely manner

Contracts / Business Management



Contract Management

- ◆ **Program Office** manages contracts with Principal Investigator organization and implementing organization, if applicable
 - If the organization has an associated NASA Management Office (NMO) the contract is managed by the NMO with input from the Program Office on the project task
- ◆ **Program Office** provides Phase A contract support as a service to SMD, however the Program Office is not involved in the selection process

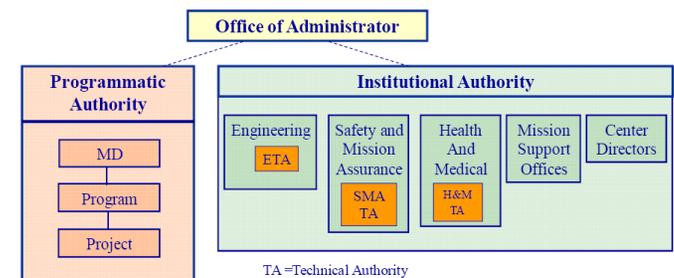
Business Management

- ◆ **Program Business Office** coordinates the annual overall program budget planning activity in conjunction with all Discovery projects
 - Results are documented in a Program Funding Agreement with each Project
- ◆ **Missions** are required to provide standard NASA financial reports
- ◆ **Missions** are responsible for the overall project budget
 - Information on project by-pass funding (e.g. direct funding to NASA centers) is provided by the Program Office
- ◆ **Missions** are required to implement Earned Value Management – developed in phase B, utilized during phase C/D



Technical Authority

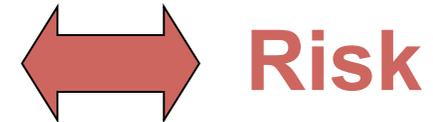
- ◆ NASA governance model provides a separation of Programmatic Authority and Institutional Authority as part of its system of “checks and balances” to provide independent oversight of programs and projects in support of overall safety and mission success.
 - Engineering Technical Authority (ETA) is provided to the Program Office from the Chief Engineer’s Office at MSFC
 - Safety and Mission Assurance (S&MA) Technical Authority is provided to the Program Office from the S&MA Office at MSFC
- ◆ TA Communication
 - Daily verbal discussions with D&NF&LQ Mission Managers
 - Frequent discussions with Project Managers and Project personnel
 - Weekly written and verbal reporting to MSFC Management
 - Ad-hoc communication as necessary
- ◆ TA Insight
 - The Program TA ensures mission success by performing independent technical insight over the various projects within the D&NF&LQ Program
 - The TA performs insight by 1) attending review meetings, 2) monitoring telecons, 3) reading status reports, and 4) following on-going issue resolutions
 - The level of insight is risk-based
- ◆ The D&NF&LQ CE utilizes technical expertise from across NASA, industry, and academia to study and address issues



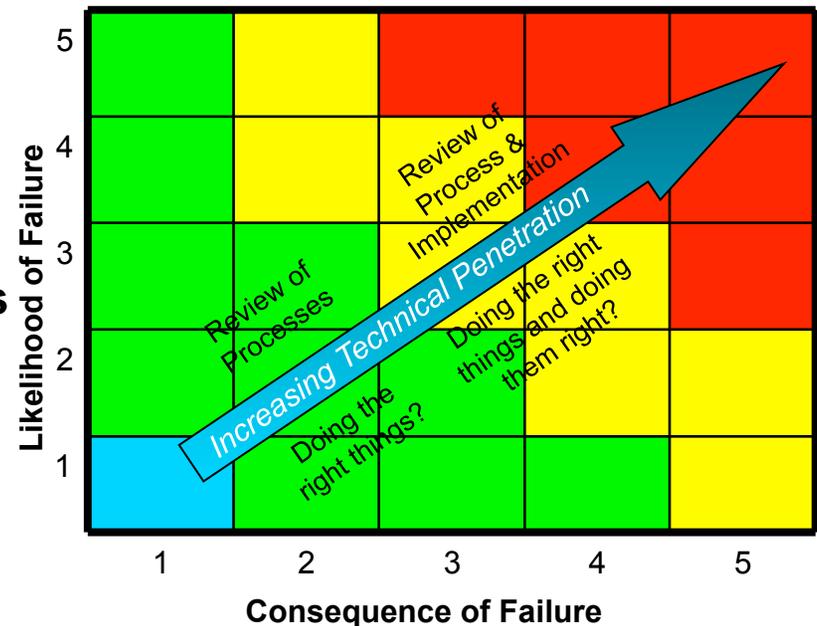
Risk Based *Insight*



- Cost cap ⇒ **cost constraint**
- Planetary missions ⇒ **schedule constraint**
- Complex instruments/mission designs ⇒ **technical constraints**



- Program Office insight effort modulated by budgetary constraints
- Risk identification through multiple vehicles
 - Formal project reporting
 - Regular and gate reviews
 - Regular interactions with project teams
 - Input from Standing Review Boards



Risk Management Process requires Mission Managers to (1) Assess and monitor resolution of *project-identified risks* and mitigations; and (2) *independently identify* and assess project risks and mitigations

Risk-Based Insight of projects, where depth of technical *insight is applied proportionally to severity* of known risks and within balance of total program's priorities and limited resources

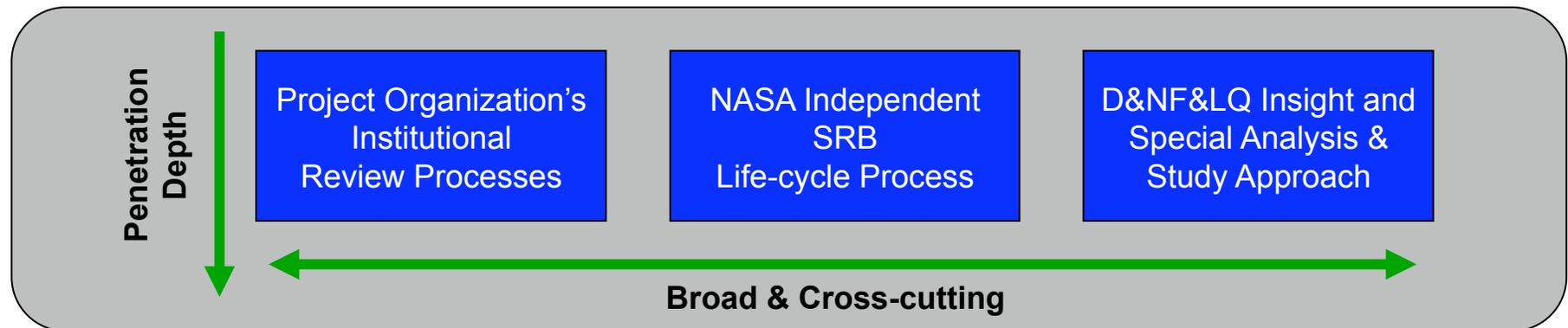
Insight/Oversight Approach



Composite Insight/Oversight Approach

Program utilizes “3-pronged” composite insight/oversight approach to achieving the “right-level” of review and analysis, expertise, and objectivity for enhancing probability of project and program success.

- ◆ Adjust insight penetration levels as required by risk/technical severity
- ◆ Broadly balance insight/oversight resources (e.g., processes, budget, schedule)
- ◆ Leverage use of all existing insight/oversight capabilities within the implementing institution, NASA, and the program office



Schedule Management

Project Schedule Assessment



- ◆ Projects in Phases B, C, & D independently maintain their detailed schedules and report on schedule performance monthly.
- ◆ Mission Managers assess project schedules periodically.
 - Program Office schedule analyst provides assessments to individual Mission Managers as requested.
 - Project schedules are included in monthly reports to the PM and NASA HQ/PSD
 - Risk management process identifies and tracks potential impacts to project schedules (and any associated impacts to cost).
- ◆ Detailed reviews of the project schedules are performed periodically.
 - Coordinated with major project milestones or special program evaluations
 - Schedules assessed for completeness and feasibility.
- ◆ Program Office schedule analyst uses various internally developed and commercially available software products and metrics to analyze project schedule performance.
- ◆ Program Office schedule analysis results are provided to and iterated with Project Management and individual project scheduling personnel.

Earned Value Management

Project EVM Assessment



- ◆ Program Office receives Earned Value Management (EVM) information, as it is available, from individual projects during Phases B, C & D.
- ◆ Program Office uses the EVM data and resultant analysis at various levels of the WBS to monitor project progress and foretell potential problem areas. Specifically,
 - Cost Performance Index (CPI)
 - Schedule Performance Index (SPI)
- ◆ Program Office participates in IBRs conducted by implementing organizations.

Joint Confidence Level

Project JCL Requirements



◆ What it is:

- Joint (cost and schedule) Confidence Level is the probability that a given project or program's cost will be equal or less than the targeted cost AND schedule will be equal or less than the targeted schedule date
- A product that helps inform management the likelihood of a projects' programmatic success
- A product that combines a projects' cost, schedule, and risk into a complete picture of the project ability to achieve cost and schedule goals

◆ What is required:

- Projects to be funded at no less than a 50% JCL
- JCLs to be developed and maintained through lifecycle from KDPC
- Project proposed cost and schedule baselines will be assessed by an independent review team
- External commitments will be based on JCL approved by the responsible Agency management council
- Projects are annually reviewed to confirm that current baselines and JCL are consistent with their annual budget submit. Significant changes to funding are to be reviewed and approved by the responsible Agency management council



Misc. Things to Consider

- ◆ The Program Level Requirements Appendix (PLRA) of the Discovery Program Plan is developed at the start of Phase B and updated after the Confirmation Review (post PDR and KDP-C)...start thinking about it in Phase A
- ◆ The Project must develop a Cost Analysis Data Requirement (CADRe) spreadsheet prior to PDR to support the JCL and the Confirmation Process
- ◆ Allow for considerations of the Standing Review Board (SRB)
- ◆ Think hard about number of test beds needed (consider fault protection/ autonomy testing)
- ◆ Watch out for overly optimistic workforce roll off estimates before launch
 - Optimistic Test Schedules
 - Verification and Validation
 - Planned Phase D work rolled into Phase E